



Maestría en astrofísica IRyA-UNAM

Problemas Contemporáneos de Astrofísica de Altas Energías

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Problemas Contemporáneos de Astrofísica de Altas Energías Contemporary Problems in Astrophysics of High Energies

General Objective:

This course will provide a broad overview of the physics and observed properties of gamma-ray bursts (GRBs) — the most luminous explosions in the Universe powered by ultra-relativistic jets. After introducing the phenomenology and observed properties of GRBs, the course will offer a detailed review of the special theory of relativity when applied to relativistic sources and the different high-energy radiative processes, all essential topics for understanding the properties of GRBs. Currently popular models of prompt GRB emission will be discussed in some detail followed by the more standard afterglow theory of relativistic blast waves. Different central engines that power the jets and different GRB progenitors will be briefly discussed. Throughout the course open problems in the field will be emphasized and recent advancements in understanding through semi-analytical and numerical simulations will be highlighted.

Professor:

[Ramandeep Gill](#)

CONTENIDO TEMÁTICO

Topics:

- Observed Characteristics and Phenomenology of GRBs

- Prompt Emission
- Afterglow
- Supernova and Kilonova Associations
- Redshift distribution and Even Rates
- Empirical Correlations

- Special Relativity

- Lorentz Transformations
- Aberration of Light and Doppler Beaming
- Superluminal Motion
- Emission from Relativistic Sources
- Transformation of Quantities Between Different Lorentz Frames



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- High Energy and Radiative Processes

- Synchrotron Emission
- Inverse Compton Scattering
- Synchrotron Self-Compton
- Pair Production and Annihilation
- Hadronic Processes

- Prompt Emission Models

- General Theoretical Framework
- Fireball Model
- Internal Shocks
- Poynting-Flux Dominated Jets
- Prompt GRB Polarization

- Afterglow Theory

- Dynamics of Relativistic Blast Waves
- Relativistic Shock Physics
- Synchrotron Spectrum
- Afterglow Light Curve and Jet Breaks
- Afterglow Polarization

- GRB Central Engine

- Accreting Black Holes
- Millisecond Magnetars
- Observational Implications

- Progenitors

- Massive Stars
- Compact Object Mergers